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89Y nuclear magnetic resonance study of Ca-doped Y 1-xCaxBa2Cu3Oy from the underdoped to the overdoped superconducting regime

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Abstract

89Y NMR linewidth, Knight shift, spin-echo dephasing, and spin-lattice relaxation measurements have been carried out in Y 1-xCaxBa2Cu3Oy. Underdoped and overdoped samples have been obtained by means of Y3+ for Ca2+ substitutions in the parent chain-empty antiferromagnetic (AF) YBa2Cu3O6.1 and in the chain-full YBa 2Cu3O7, respectively. Unexpected effects, as the divergence of relaxation rate with the concurrent broadening of the NMR line in the underdoped superconducting phase and the inadequacy of the Korringa relation between the relaxation rate 1/T1 and Knight shift, even in the overdoped regime, suggest that a revision of the commonly accepted view of YBa2Cu3O6+y compounds is required. In particular the linear temperature dependence of T1 -1 and the temperature behavior of Knight shift cannot be accounted for over all the temperature range. In the underdoped superconducting phase the divergence of 1/T1 on cooling is associated with the slowing down of excitations possibly related to sliding motions of orbital currents, or with the concurrent freezing of AF correlated spins. Echo-dephasing measurements evidence an extreme slowing down of longitudinal spin fluctuations which appear to be driven by a different dynamic, related either to flux line motions or to 63,65Cu spin-lattice relaxation.